**Single-Slit Interference**

Although Thomas Young first discovered interference using a double slit apparatus, it was soon found that even a single slit will produce interference. Even though a single slit is the size of a pinhole, enough light can pass through it to interfere with itself.

ϑ1

**λ**

*w*

For a single slit, we look at the difference in path length between a ray from the top of the slit and a ray from the bottom of the slit. If the screen where the rays interfere is far away compared to the width of the slit, then the rays can be thought to leave the slit parallel to each other.

The first **minimum** (i.e. the first dark fringe next to the central maximum) occurs when the path difference between a ray from the top of the slit and a ray from the bottom is one wavelength.

**sinϑ1 = \_\_\_\_\_\_\_\_\_\_**

**maxima (bright fringe): (m + 1/2) λ= wsinϑm**

**minima (dark fringe): mλ = wsinϑm**

where m = 1, 2, 3, ...and represents the order of the maxima or minima

2nd minimum

1st minimum

y1

y2

*w*

ϑ1

ϑ2

*L*

**sinϑ1 = \_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_**

**λ** **= \_\_\_\_\_\_\_\_\_\_**

**∴ λ** **= \_\_\_\_\_\_\_\_\_\_**

For very small angles, sinϑ ≅ tanϑ

**sinϑ1 = \_\_\_\_\_\_\_\_\_\_**

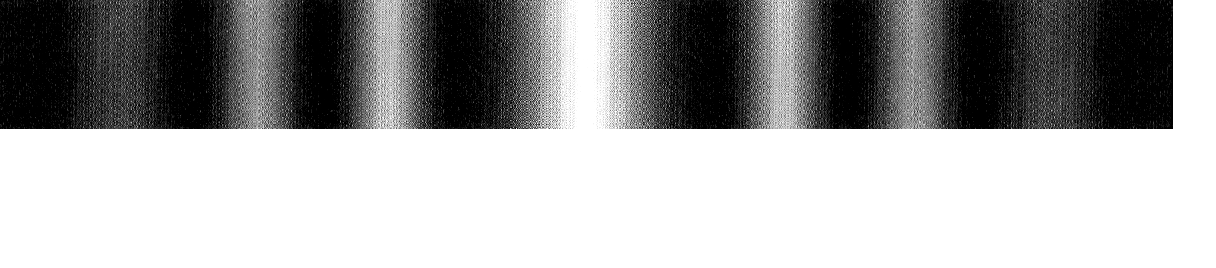
and

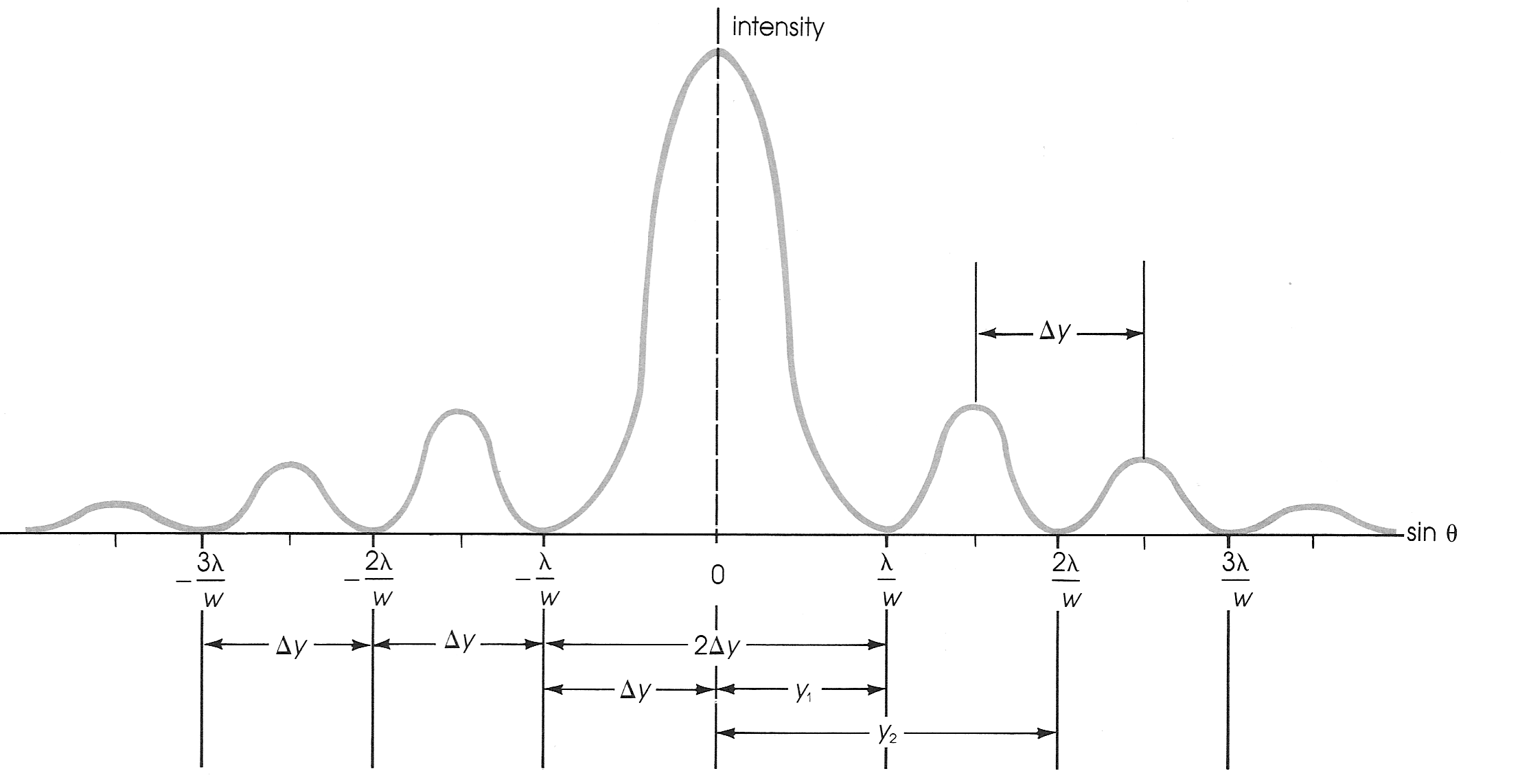
for the first minimum,

***w*sinϑ1 = λ**

The pattern produced by light directed through a single slit consists of a bright central region called the **central maximum.** On either side of the central maximum there are dark fringes alternating with progressively less intense bright fringes.

*How does the width of the central maximum compare to the other maxima?*

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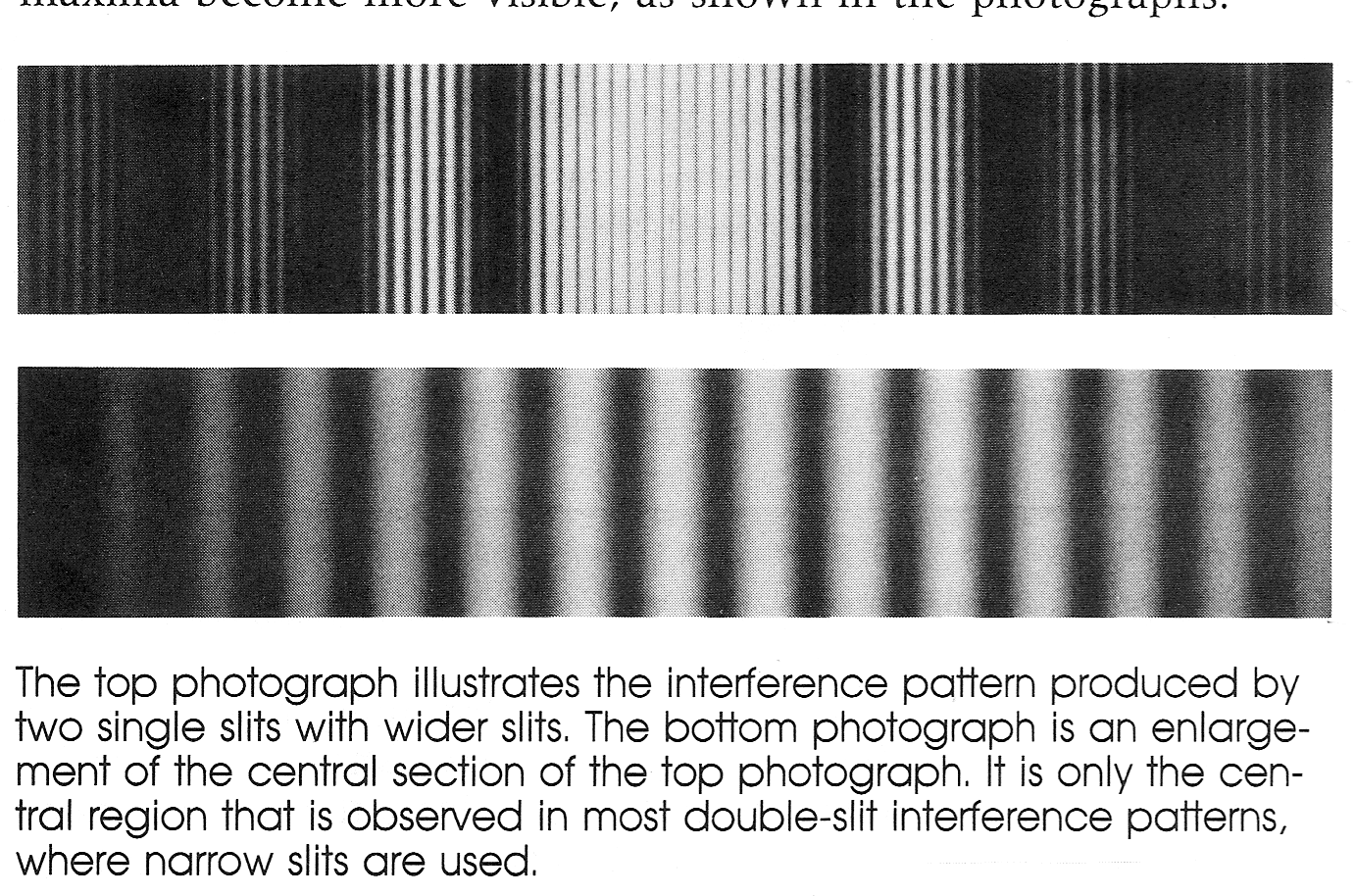
(Diagrams above copied from: Martindale, D. et al. (1986). Fundamentals of physics: a senior course. Toronto: Heath.)

eg.➀ Violet light with a wavelength of 404 nm is used to generate a single-slit diffraction pattern. The slit is 6.9 x 10-5 m wide and the screen is 85 cm from the slit. What is the width of the central maximum in i) centimetres and ii) degrees?

eg.➁ An interference pattern is generated on a screen 6.8 m away from a single slit. Monochromatic light with a wavelength of 445 nm is used. A third-order minimum (i.e. third dark fringe from the middle of the central maximum) occurs at 72 cm. What is the width of the slit?

Combining Single and Double Slit Interference patterns

The reality is, when viewing the interference pattern of a double slit apparatus, you will also see single slit interference mixed in. The combined effect looks like this:



The double slit interference causes the regularly spaced thin black and white bands. The large, bright central maximum followed by dimmer and dimmer maxima is the result of single slit interference.